

Patent Application of Michael J. McNitt for "Method and System for Physical Motion Analysis and Training of a Golf Club Swing Motion Using Image Analysis Techniques"

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CLAIMS

What is claimed is:

1. An analysis tool for capturing and analyzing physical motion of a golf putter during a putting stroke, comprising:
 - (a) one or more video image recording devices;
 - (b) a computer processing environment for processing and storing video image data recorded by said video image recording devices;
 - (c) a light reflective element attached to a surface of said golf putter whereby providing means to detect and measure motion of said golf putter;
 - (d) means for processing said video image data containing recorded image representations of said light reflective element whereby determining a plurality of motion measurements of said light reflective element, and thereby said golf putter to which said light reflective element is attached;
 - (e) a display device providing means for presenting said motion measurements;
 - (f) means for calibration such that measurement error caused by distortion or misalignment of said image recording devices is substantially reduced; whereby providing objective physical motion information to aid in instruction and correction of said putting stroke.
2. The analysis tool as defined in claim 1 further comprising a means for automatically starting a detection process as part of processing said video image data based on a

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predetermined amount of change of said video image data contained within a user defined hot-spot region as a function of time.

3. The analysis tool as defined in claim 1 further comprising a calibration fixture containing a guiding feature and visual calibration target aligned to one another to aid in the process of calibrating and aligning said analysis tool.
4. The calibration fixture as defined in claim 3 wherein said guiding feature is a slot of sufficient dimensions to guide a rolling golf ball to determine a direction vector said golf ball must travel along to successfully reach a target zone.
5. The calibration fixture as defined in claim 3 wherein said visual calibration target is a uniform pattern of distinct features contained on a surface of said calibration fixture used to calibrate and compensate for distortion or misalignment of said video image recording devices.
6. The analysis tool as defined in claim 1 wherein said video image recording device is a video camera with a composite video output.
7. The analysis tool as defined in claim 1 wherein said video image recording device is a digital camcorder with a composite video output.

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8. The analysis tool as defined in claim 1 wherein said light reflective element is reflective adhesive tape, shaped to have at least one straight edge, and attached to a surface of said golf putter.
9. The analysis tool as defined in claim 1 whereby said means for processing said video image data uses a detection process and an analysis process to determine the position and angle of said light reflective element.
10. An analysis tool for capturing and analyzing physical motion of a golf club such as a pitching wedge or sand wedge during a swing motion, comprising:
 - (a) one or more video image recording devices;
 - (b) a computer processing environment for processing and storing video image data recorded by said video image recording devices;
 - (c) a light reflective element attached to a surface of said golf club whereby providing means to detect and measure motion of said golf club;
 - (d) means for processing said video image data containing recorded image representations of said light reflective element whereby determining a plurality of motion measurements of said light reflective element, and thereby said golf club to which said light reflective element is attached;
 - (e) a display device providing means for presenting said motion measurements;

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- (f) means for calibration such that measurement error caused by distortion or misalignment of said image recording devices is substantially reduced; whereby providing objective physical motion information to aid in instruction and correction of said swing motion.

11. A method of using a computer processor based analysis tool to record and analyze physical motion of a golf putter during a putting stroke wherein a light reflective element is attached to said golf putter, comprising:

- (a) Recording and storing video image data as a sequence of frames spaced a certain time interval from one another representing said light reflective element using one or more video image recording devices during said putting stroke;
- (b) calibrating elements of said analysis tool to calculate correction factors to compensate for distortion or misalignment introduced by said video recording devices during recording of the said video image data using a calibration fixture;
- (c) processing said video image data to detect certain features contained in each said frame of said video image data based on experimentally predetermined threshold conditions whereby a location and angle of said light reflective element can be determined for each said frame in a saved sequence, and thereby said golf putter to which said light reflective element is attached;
- (d) processing said location and angle using said correction factors to calculate corrected location and angle values for each said frame;

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(e) calculating various secondary motion data of said golf putter using said corrected location and angle values;

(f) displaying said corrected location, angle and said secondary motion data numerically or pictorially;

whereby providing objective physical motion information to aid in instruction and correction of said putting stroke.

12. The method as defined in claim 11 further comprising:

aligning said calibration fixture containing a guiding feature to guide a rolling golf ball such that a direction vector can be determined that guides said golf ball as it rolls to successfully reach a predetermined target zone.

13. The method as defined in claim 11 further comprising:

recording an image of a special visual calibration target, as part of said calibration fixture, placed in an area where said putting stroke occurs, recording and processing said target image to align said analysis tool to a predetermined direction vector whereby precise physical alignment of said video recording device to said vector is not required .

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14. The method as defined in claim 11 whereby said location and angle of said light reflective element are determined by a video capture process, a detection process, and analysis process..

15. The method as defined in claim 14 whereby said detection process employs digital image processing algorithms to find a center location and edges of the representation of said reflective element in each said frame of video image data, thereby determining position and angle of said golf putter.

16. The method as defined in claim 11 whereby said secondary motion data is comprised of stroke tempo, back stroke distance, follow through distance, off-line distance, and variance from ideal path.

17. The method as defined in claim 11 further comprising:
storing and defining one or more said putting strokes and associated said corrected location, angle and said secondary motion data to belong to a session such that there exists a plurality of said sessions containing one or more sets of putting stroke data comprised of said corrected location, angle and said secondary motion data.

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18. The method as defined in claim 17 further comprising:

performing a statistical analysis for said corrected location, angle and said secondary motion data for all said putting strokes defined as belonging to a said session such that there is independent statistical analysis information for each said session.

19. The method as defined in claim 18 whereby said statistical analysis information for each said defined session is comprised of a mean value and standard deviation for said corrected location, angle and said secondary motion data and information representing the percentage of said strokes that resulted in a struck golf ball successfully reaching a predetermined target zone.

20. The method as defined in claim 18 further comprising:

comparing said statistical analysis for each said session and visually indicating and displaying which said session contained superior said putter stroke data by using a weighted assessment analysis of said statistical analysis for each said session.